Enhanced P/M Processing of Superalloys for Aircraft Engine Components

Status: Technical Success

PROBLEM / OBJECTIVE

This project demonstrated the applicability of enhanced powder metallurgy (P/M) processing of superalloys to the cost-effective production of superior quality weapon system components, specifically, turbine disks for aircraft engines. The project also developed enhanced P/M processing of Udimet-720LI, which involves a combination of powder production, consolidation, extrusion, isothermal forging, heat treatment, ultrasonic inspection, machining and testing technologies.

The project also:

- Applied enhanced P/M processing to the manufacture of the Rolls-Royce AE1107C engine, Stage 3 turbine disks.
- Validated the properties and performance of the disks through material testing, low cycle fatigue spin testing and overspeed/burst engine testing.
- Assessed enhanced P/M processing technologies and develop modeling tools to apply them to other superalloy grades and aircraft components.

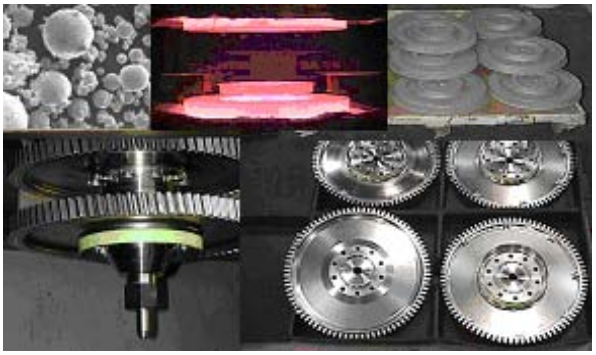
ACCOMPLISHMENTS / PAYOFF

Process Improvement:

- Demonstrated the cost benefits of selective ultrasonic inspection.
- Developed process models during technology assessment for HIP, extrusion, isothermal forging and residual stress prediction.
- Achieved 25% lower 'buy to fly' weight.
- 40 times better probability of defect detection in P/M disks.

Implementation and Technology Transfer:

- Produced four AE1107C Stage 3 machined disks and spin-tested two of them to 170,000 cycles with no indications in an FPI test.
- Conducted end-of-project demonstration and distributed a detailed final report.
- Participated in conferences such as DMC'99, DMC'00, Superalloys'96, Superalloys'00 and user group meetings.



TIME LINE / MILESTONE

Start Date: August 1996
End Date: August 2000

FUNDING

Total ManTech Investment: $4.4M

PARTICIPANTS

- Rolls-Royce Corporation
- Ladish Co., Inc.
- Special Metals Corporation
- National Center for Excellence in Metalworking Technologies
- Naval Air Systems Command